BACTERIOLOGICAL WATER QUALITY OF HODSON (THREE MILE) LAKE PARRY SOUND

1974

MINISTRY OF THE ENVIRONMENT

RECREATIONAL LAKES SELF-HELP PROGRAM.

BACTERIOLOGICAL WATER QUALITY

of

HODSON (THREE MILE) LAKE

PARRY SOUND

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by

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HODSON (THREE MILE) LAKE

INTRODUCTION

The Recreational Lakes Self-Help program was es-
tablished by the Ontario Water Resources Commission with
interested cottager associations in 1971, and continued
by the Ministry of the Environment since then to assist
cottage owners to determine the bacteriological water
quality of their lake. The Self-Help investigations can
be useful in indicating possible contamination sources
which require later M.O.E. surveys, or in assuring interes-
ted cottagers that the bacteria present are from natural
sources without health hazards. The M.O.E. bacterio-
logical survey is of special importance for typing and
pinpointing bacterial pollution sources.

The success of this program depended on the en-
thusiastic support of the cottagers association, and es-
pecially Mr. K.G. Watson who took the samples and delivered
them to the Ministry of the Environment Toronto laboratory
for analysis.

Bacteriological Methods and Interpretation

Samples of lakewater were taken by recommended procedures (see Appendix A-5) regularly in July, August and September of 1974 at 15 selected sampling locations (see map).

The numbers of bacteria in each of three types of 'indicator' organisms were determined on each sample. The three bacterial types, total coliform, fecal coliform and fecal streptococcus (enterococcus) bacteria are all common to man and other warm blooded animals, and are found in the colon and feces in tremendous numbers. Many diseases common to man are transmitted by feces, consequently, the probability of occurrence of these diseases is usually highest in areas where the water is contaminated. These indicator organisms in water connote the possible presence of disease causing organisms (see Appendix, A-1).

The geometric mean,[1] the most appropriate representative value of the data for each station, was calculated, and evaluated with respect to the Ministry of the Environment Recreational Criteria,[1] which states:

> 'Where ingestion is probable, recreational waters can be considered impaired when the coliform (TC), fecal coliform (FC), and/or enterococcus (fecal streptococcus, FS) geometric mean density exceeds 1000, 100 and/or 20 per 100 ml respectively, in a series of at least ten samples per month, ...1

[1] Guidelines and Criteria for Water Quality Management in Ontario, M.O.E. 1974

A proper estimate of the bacterial population re-
quires several measurements of bacterial density over a
period of time which can then be averaged as a geometric
mean. Therefore the sampling frequency in the Recreational
Criteria is most important, and is usually achieved only
with the M.O.E. and not the Self-Help surveys. The Self-
Help program gives a good estimate of the bacteriological
water quality of the lake. Single unconfirmed high values
may indicate intermittant pollution, but must be inter-
preted cautiously.

The most important of the bacterial indicators of
water quality is the fecal coliform density. These bac-
teria are largely Esherichia coli, an inhabitant of the
intestines of man and animals. High levels of fecal coli-
forms without a corresponding level of fecal streptococcus
may indicate some human contamination and an accompanying
health hazard to users of the water.

Microbial contamination by raw or inadequately
treated sewage does not significantly change the appearance
of the water but poses an immediate public health hazard
when the water is used for drinking or swimming. This type
of pollution can be remedied by preventing wastes from
reaching a lake. If this is the only source of pollution,
satisfactory water quality will then return since disease
causing bacteria do not usually persist in lake water.

Physical Characteristics   (Ministry of Natural Resources, Bracebridge Office)

Surface Area	876.9 acres
Maximum Depth	26'
Mean Depth	13.29'
Volume	11,654.56 acre feet

Results & Discussion

The self-help sampling program showed that the bacteriological water quality of Hodson Lake in 1974 was very good. The overall geometric mean densities were 169 TC, 1 FC and 2 FS per 100 ml (Table I) for all sampling periods. Slightly higher individual counts of fecal strep-tococcus were observed near the south-western shoreline (Stations 4 & 5).

Hodson Lake was sampled previously in 1971. The mean densities in July and August of 1971 were 61 TC, 1 FC and 1 FS per 100 ml and 37 TC, 1 FC and 2 FS per 100 ml respectively. These values are generally lower than the July and August values in 1974 (Table II). The secchi disc reading improved from 16.1' in 1971 to 17.6' in 1974 for the July and August period. (M.O.E. secchi disc program) The rise in bacterial densities in 1974 could be due to natural events such as the "Rainfall Effect" (see Appendix A-2).

Based on the results of the data collected, Hodson Lake had good water quality with no specific area contri-buting large numbers of fecal bacteria. The secchi disc readings for Hodson Lake 1974 (17') indicated good water clarity which is one measure of good water quality. No surface water is considered potable however, without prior treatment including disinfection (see Appendix A-3).

TABLE I

HODSON LAKE 1974

STATION NUMBER	NO. OF PIECES OF DATA	GEOMETRIC MEAN BACTERIAL DENSITIES		
		TC/100 ml	FC/100 ml	FS/100 ml
1	15	68	1	2
2	15	20	1	1
3	15	96 (14)	1	2
4	15	199	1	2
5	15	388 (14)	2	3
6	15	236	1	2
7	15	159	1	2 (14)
8	16	120	1	1
9	16	244	1	1
10	16	.203	1	1
11	16	183	1	2
12	16	119	1	1
13	16	251	1	2
14	16	162	1	1
15	16	224	1	1
Overall Geometric Means	(233)	169	1	2

TABLE II

HODSON LAKE 1974

GEOMETRIC MEAN BACTERIAL DENSITIES

STATION	TC/100 ml			FC/100 ml			FS/100 ml		
	JUL	AUG	SEP	JUL	AUG	SEP	JUL	AUG	SEP
1	179	58	38	2	1	1	1	2	1
2	72	518	57	1	1	1	1	2	1
3	527	5	126	1	1	1	2	1	1
4	88	268	195	1	1	1	3	2	3
5	298	388	347	1	3	1	7	1	3
6	476	150	139	1	1	1	3	1	2
7	233	39	148	1	1	1	2	1	1
8	78	188	66	1	1	1	1	1	1
9	673	698	37	1	1	1	1	2	1
10	408	65	177	1	1	1	1	1	1
11	247	228	88	1	2	1	2	1	1
12	109	184	55	1	2	1	2	1	1
13	164	681	76	1	1	1	3	1	1
14	177	103	112	1	1	1	1	1	1
15	268	793	90	1	1	1	1	1	1

HODSON LAKE
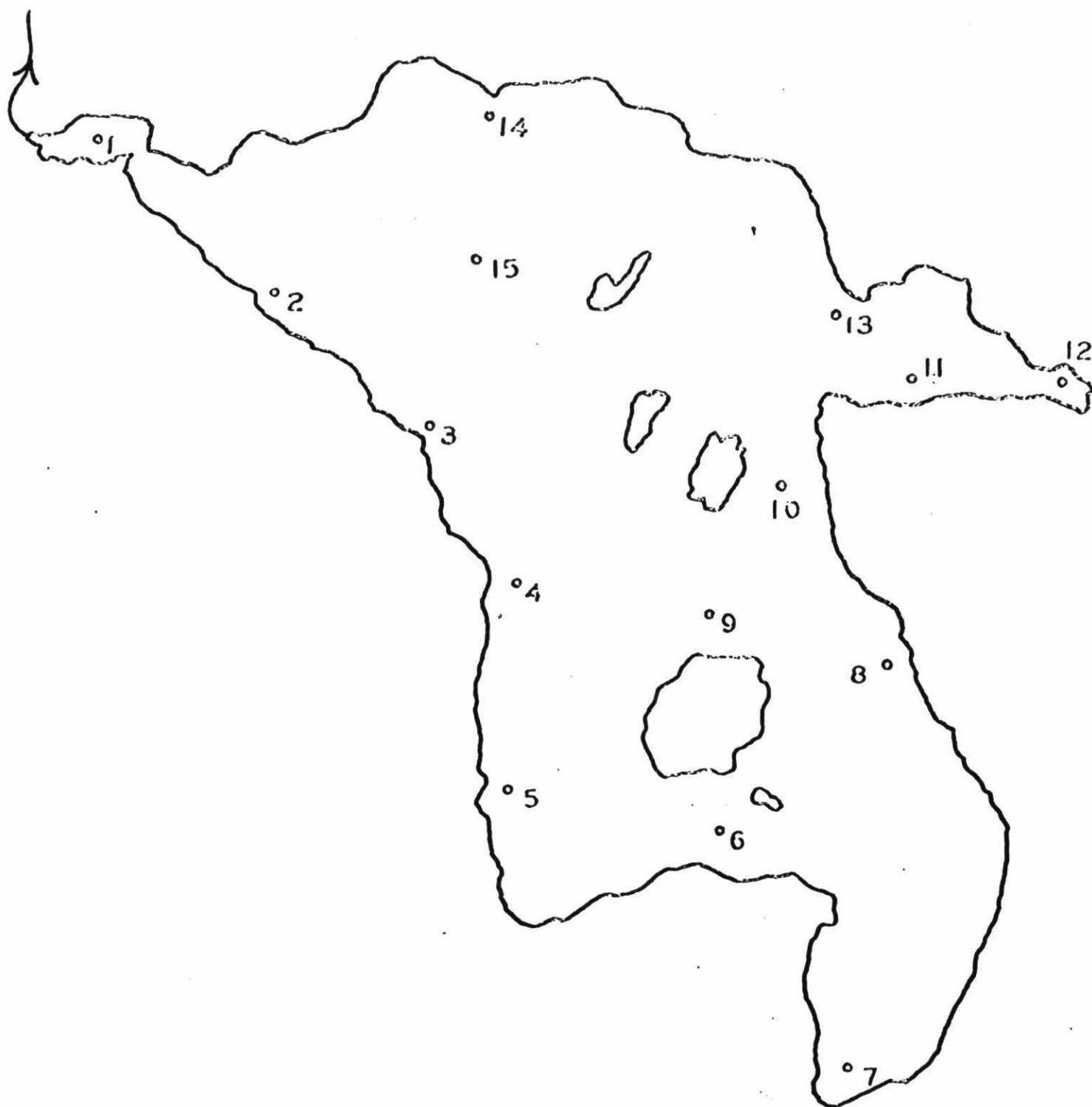
APPENDIX

INFORMATION OF GENERAL INTEREST TO COTTAGERS
MICROBIOLOGY OF WATER

For the sake of simplicity, the microorganisms in water can be divided into two groups: the bacteria that thrive in the lake environment and make up the natural bacterial flora; and the disease causing microorganisms, called pathogens, that have acquired the capacity to infect human tissues.

The "pathogens" are generally introduced to the aquatic environment by raw or inadequately treated sewage, although a few are found naturally in the soil. The presence of these bacteria does not change the appearance of the water but poses an immediate public health hazard if the water is used for drinking or swimming. The health hazard does not necessarily mean that the water user will contract serious waterborn infections such as typhoid fever, polio or hepatitis, but he may catch less infections of gastroenteritis (sometimes called stomach flu), dysentery or diarrhea. Included in these minor afflictions are eye, ear and throat infections that swimmers encounter every year and the more insidious but seldom diagnosed, sub-clinical infections usually associated with several water born viruses. These viral infections leave a person feeling not well enough to enjoy holidaying although not bedridden. This type of microbial pollution can be remedied by preventing wastes from reaching the lake and subsequently water quality will return to satisfactory conditions within a relatively short time (approximately one year) since disease causing bacteria do not usually thrive in an aquatic environment.

The other bacteria live and thrive within the lake environment. These organisms are the instruments of biodegradation. All organic matter in the lake will be used as food by these organisms and will give rise, in turn to subsequent increases in their numbers. Organic matter from natural sources as well as that from sewage, kitchen wastes, oil and gasoline are readily attached by these lake bacteria. Unfortunately, biodegradation of large

quantities of organic wastes by organisms uses correspond-
ingly large amounts of dissolved oxygen. If the organic
matter content of the lake is high enough, these bacteria
will deplete the dissolved oxygen supply in the bottom
waters and so threaten the survival of many deep water
fish species.

RAINFALL AND BACTERIA

The "Rainfall Effect" has been documented in previous
surveys of Recreational Lakes. Heavy precipitation has been
shown to flush the land area around the lake and the sub-
sequent runoff will carry available contaminants including
sewage organisms as well as natural soil bacteria with it
into the water.

Total coliforms, fecal coliforms and fecal streptococci,
as well as other bacteria and viruses which are found in
human waste disposal systems, can be washed into the lake.
This phenomenon is particularly evident in Precambrian areas
where there is inadequate soil cover and in fractured lime-
stone areas where fissures in the rocks provide access to
the lake.

Melted snow provides the same transportation function
for bacteria, especially in an agricultural area in winter
where manure spreading is carried out on top of the snow.

Previous data from sampling points situated 50 to
100 feet from shore indicate that contamination from shore
generally shows up within 12 to 48 hours after a heavy
rainfall.

WATER TREATMENT

Lake and river water is open to contamination by man,
animals and birds (all of which can be carriers of disease);
consequently, NO SURFACE WATER MAY BE CONSIDERED SAFE FOR
HUMAN CONSUMPTION without prior treatment, including dis-
infection. Disinfection is especially critical if coliforms
have been shown to be present.

Disinfection can be achieved by:

(a) Boiling:
   Boil the water for a minimum of five minutes
   to destroy the disease causing organisms.

(b) Chlorination Using a Household Bleach Con-
   taining 4 to 5.1/4% Available Chlorine:
   Eight drops of a household bleach solution
   should be mixed with one gallon of water and
   allowed to stand for 15 minutes before drinking.

(c) Continuous Chlorination:
   For continuous water disinfection, a small
   domestic hypochlorinator (sometimes coupled
   with activated charcoal filters) can be ob-
   tained from a local plumber or water equip-
   ment supplier.

(d) Well Water Treatment:
   Well water can be disinfected using a house-
   hold bleach (assuming strength at 5% available
   chlorine) if the depth of water and diameter
   of the well are known.

CHLORINE BLEACH
per 10 ft depth of water

Diameter of Well Casing in Inches	One to Ten Coliforms	More than Ten Coliforms
4	.5 oz.	1 oz.
6	1 oz.	2 oz.
8	2 oz.	4 oz.
12	4 oz.	8 oz.
16	7 oz.	14 oz.
20	11 oz.	22 oz.
24	16 oz.	31 oz.
30	25 oz.	49 oz.
36	35 oz.	70 oz.

Allow about six hours of contact time before using the water.

Another bacteriological sample should be taken after
one week of use.

Water Sources (spring, lake, well, etc.) should be inspected for possible contamination routes (surface soil, runoff following rain and seepage from domestic waste disposal sites). Attempts at disirfecting the water alone without removing the source of contamination will not supply bacteriologically safe water on a continuing basis.

There are several types of low cost filters (ceramic, paper, carbon, diatomaceous earth sometimes impregnated with silver, etc.) that can be easily installed on taps or in water lines. These may be useful to remove particles if water is periodically turbid and are usually very successful. Filters, however, do not disinfect water but may reduce bacterial numbers. For safety, chlorination of filtered water is recommended.

SAMPLE-TAKING PROCEDURE

A maximum of 24 hours is permitted between time of sample collection and examination. The sampling bottle shall be kept unopened until the moment it is to be filled. After the bottle is screwed into place on the sample rod, the plastic covering is peeled off; the cap then is removed from the bottle using sterile technique. During sampling the cap and neck of the bottle should not be handled and should be protected from contamination. The bottle is then inverted and plunged into the water to a depth of about three feet. Enough air space should be left in the bottle to facilitate mixing of the sample by shaking before examination. Excess is poured off. The sample should be stored in an ice cooler immediately.

If the sample is being taken from a tap, the tap should be opened fully and the water allowed to run to waste for two or three minutes first. The flow from the tap should be restricted to one that will fill the bottle without splashing.

In collecting samples directly from a river, stream, lake, reservoir, spring or shallow well, the aim must be to obtain a sample that is representative of the water. From lakes, it is desirable to take samples 15 to 20 feet from shore and at a depth of three feet (1 meter) wherever

possible. In shallower water, sample at the mid depth.
At the mouth of a stream, sample at the mid point of a
line continuing the lake shore.